

CLAIMS

1. A method for producing carbon monoxide and/or hydrogen and/or a mixture of hydrogen and carbon monoxide by cryogenic distillation, comprising the steps of:
- 5           i)           producing a feed mixture comprising at least carbon monoxide and hydrogen in a production apparatus (9);
- 10          ii)          separating the feed mixture (3) comprising at least carbon monoxide and hydrogen by cryogenic distillation in a separating unit (CB) comprising at least one column;
- 15          iii)         collecting carbon monoxide (7) and/or hydrogen (8) and/or a mixture of hydrogen and carbon monoxide from the separating unit;
- iv)         in a first operating mode, sending a first quantity of feed mixture (3) to be separated to the separating unit;
- 20          v)          in the first operating mode, producing a quantity of end product that may be carbon monoxide (7), hydrogen (8) or a mixture thereof;
- vi)         in a second operating mode, sending a second quantity of feed mixture (3) to be separated from the production apparatus to the separating unit, a smaller quantity than the quantity sent in the first operating mode;
- 25          vii)         in the second operating mode, producing a quantity of end product (5, 8), a smaller quantity than the quantity produced during the first operating mode;
- 30          viii)        in the second operating mode, drawing off from the separating unit at least one recycle gas (6) containing carbon monoxide and/or hydrogen and/or methane and having a different composition from the composition of the feed mixture sent to the separating unit in the first operating mode, and sending at least one recycle gas to the separating unit to be separated therein and;
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ix) in the second operating mode, modifying the flow rate and composition of the feed mixture (3) produced by the production apparatus, according to the flow rate and composition of the at least one recycle gas.

2. The method as claimed in claim 1, in which the feed mixture (3) contains up to 10 mol% of methane and/or up to 10 mol% of nitrogen and/or up to 10 mol% of other impurities.

3. The method as claimed in either of claims 1 and 2, in which one (the) recycle gas (6) contains at least 5 mol% of carbon monoxide.

4. The method as claimed in either of claims 1 and 2, in which one (the) recycle gas (6) contains at least 25 mol% of hydrogen.

5. The method as claimed in one of the preceding claims, in which at least one recycle gas (6) is recycled only during the second operating mode when the need of one of the products (7, 8) falls below a threshold.

6. The method as claimed in one of the preceding claims, in which the composition and/or flow rate of the feed mixture produced by the production apparatus (9) is modified during the second operating mode so that the carbon monoxide content of the second quantity of feed mixture decreases if the recycle gas (6) is richer in carbon monoxide than the first quantity of feed mixture (3) and/or so that the carbon monoxide content of the second quantity of feed mixture increases if the recycle gas is less rich in carbon monoxide than the first quantity of feed mixture.

7. The method as claimed in one of the preceding claims, in which the composition of the feed mixture (3) produced by the production apparatus (9) is modified during the second operating mode so that the hydrogen content of the second quantity of feed mixture decreases if the recycle gas is richer in hydrogen than the first quantity of feed mixture and/or so that the hydrogen content of the second quantity of feed mixture increases if the recycle gas is less rich in hydrogen than the first quantity of feed mixture.
8. The method as claimed in one of the preceding claims, in which the composition and/or flow rate of the feed mixture produced by the production apparatus (9) is modified during the second operating mode so that the flow rate of the feed mixture entering the separating unit does not differ by more than 50% from the flow rate sent during the first mode.
9. The method as claimed in one of the preceding claims, in which the composition and/or flow rate of the feed mixture produced by the production apparatus (9) is modified during the second operating mode so that the carbon monoxide content of the feed mixture entering the separating unit does not differ by  $\pm 5\%$  from the carbon monoxide content of the feed mixture entering the separating unit (CB) sent during the first mode.
10. The method as claimed in one of the preceding claims, in which the composition and/or flow rate of the feed mixture produced by the production apparatus (9) is modified during the second operating mode so that the hydrogen content of the feed mixture entering the separating unit (CB) does not differ by  $\pm 10\%$  from the hydrogen content

of the feed mixture entering the separating unit sent during the first mode.

- 5 11. The method as claimed in one of the preceding claims, in which the composition and/or flow rate of the feed mixture produced by the production apparatus (9) is modified during the second operating mode by modifying the operation of the production apparatus.
- 10 12. The method as claimed in claim 11, in which the operation of the production apparatus (9) is modified by the following means:
- 15 i) by varying the ratio of carbon vapor in the feed to the production apparatus if the production apparatus comprises a steam methane reformer (SMR) and/or
- 20 ii) by varying the operating temperature of at least one component of the apparatus, optionally the reaction temperature of the reformer (SMR) and/or
- iii) by varying the flow rate of recycled carbon dioxide (2) from a carbon dioxide stripper (MDEA) to a reformer (SMR) and/or
- 25 iv) by varying the flow rate (1) feeding the production apparatus and/or
- v) by varying the oxygen/carbon ratio of the feed to the production apparatus (if the production apparatus operates by partial oxidation).
- 30 13. An installation for producing hydrogen and/or carbon monoxide and/or a mixture of hydrogen and carbon monoxide, by separation, by cryogenic distillation, of a feed mixture containing at least carbon monoxide and hydrogen, comprising a
- 35 production apparatus (9) for producing the feed mixture (3), means for sending the feed mixture to a separating unit (CB), means for collecting hydrogen (8) and/or carbon monoxide (7) and/or a

- 5 mixture of both, drawn off as product(s) from the separating unit, means for drawing off at least one recycle gas (6) from the separating unit, means for sending the recycle gas upstream of the separating unit to be separated with the feed mixture issuing from the production apparatus, and means for modifying the flow rate and composition of the feed mixture by modifying the operation of the production apparatus according to the flow rate and composition of at least one recycle gas.
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14. The installation as claimed in claim 13, comprising means for detecting the composition and flow rate of the at least one recycle gas and of the feed mixture.
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15. The installation as claimed in either of claims 13 and 14, comprising means for initiating the recycling of the at least one recycle gas (6) if the need of product (5, 8) falls below a threshold, and means for stopping the recycling of the at least one recycle gas if the need of the same product increases above a (the) threshold.
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- 25 16. An installation as claimed in one of claims 13 to 15, in which the separating unit (CB) contains a methane scrubbing column and/or a nitrogen scrubbing column and/or a carbon monoxide scrubbing column and/or a stripping column and/or a distillation column.
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